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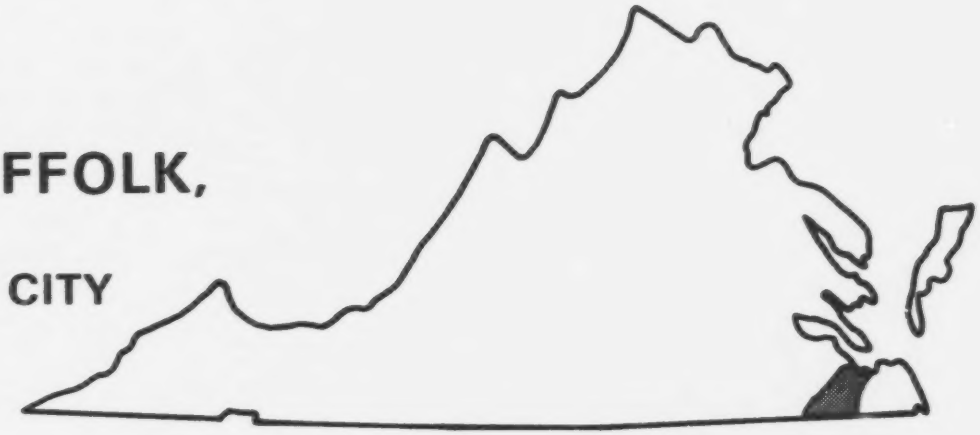
FLOOD INSURANCE STUDY

CITY OF SUFFOLK, VIRGINIA
INDEPENDENT CITY



NOVEMBER 16, 1990

Federal Emergency Management Agency

COMMUNITY NUMBER - 510156

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision (LOMR) process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Flood Insurance Study Effective Date: NOVEMBER 16, 1990

Flood Insurance Study Revised:

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FLOOD INSURANCE STUDY
CITY OF SUFFOLK, INDEPENDENT CITY, VIRGINIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Suffolk, Independent City, Virginia, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by the Norfolk District of the U. S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-84-E-1506, Project Order No. 1, Amendment No. 20. This work was completed in October 1987.

1.3 Coordination

On February 2, 1984, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives of FEMA, the city, and the COE (the study contractor) to determine the streams to be studied by detailed methods. Contacts with various Federal and State agencies were made during the course of the study in order to minimize possible hydraulic and hydrologic conflicts. A search for basic data was made at all levels of government.

On DECEMBER 21,1989 , a final CCO meeting was held with representatives of FEMA, the city, and the study contractor to review the results of the study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Suffolk, Virginia. The area of study is shown on the Vicinity Map (Figure 1).

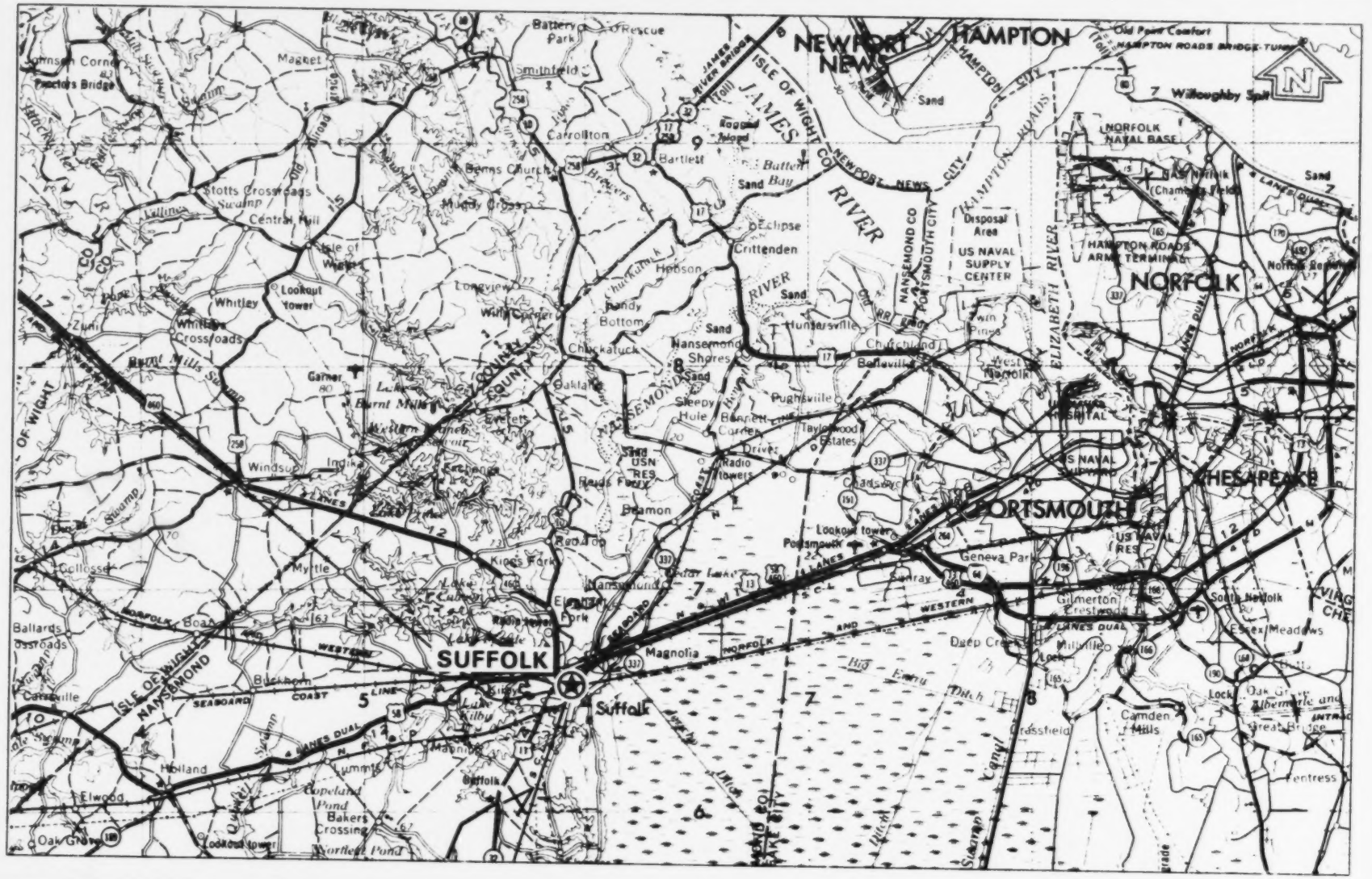
Shingle Creek was studied by detailed methods from its confluence with the Nansemond River to a point approximately 650 feet upstream of State Route 642. Tidal flooding from Hampton Roads, which affects the James River and the Nansemond River and their adjoining estuaries, was also studied by detailed methods. The effects of wave action were considered in the tidal analyses. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through October 1992.

All or portions of the following flooding sources were studied by approximate methods: Shingle Creek, the Blackwater River, Kingsale Swamp, Chuckatuck Creek, Western Branch Reservoir, Lake Prince, Lake Burnt Mills, Lake Meade, Lake Cohoon, Lake Kilby, Cohoon Creek, Eley Swamp, Speights Run, Great Dismal Swamp, Adams Swamp, Pine Swamp, Moss Swamp, Cypress Swamp, Dragon Swamp, Council Swamp, Somerton Creek, March Swamp, Mill Swamp, Chapel Swamp, Jones Swamp, Quaker Swamp, Sleepy Swamp, Crumps Mill Pond, Cedar Lake, Pitchkettle Creek, Norfleet Pond, and Spivey Swamp. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Suffolk.

2.2 Community Description

The City of Suffolk is located in southeastern Virginia. It is bordered by the unincorporated areas of Isle of Wight County and Southampton County to the west, the State of North Carolina to the south, the Cities of Chesapeake and Portsmouth to the east, and the James and Nansemond Rivers - Hampton Roads to the north. The city has a land area of approximately 430 square miles, which includes a portion of the Great Dismal Swamp National Wildlife Refuge in the eastern part of the community (Reference 1). In 1974 the Cities of Suffolk and Nansemond (incorporated as a city in 1973) merged to become the new city of Suffolk, the largest city (in land area) in Virginia and the fifth largest in the United States (References 1 and 2).

The population of the city was 47,621 in 1980 (Reference 3). The principal occupations of its residents are agriculture and manufacturing; however, non-manufacturing business such as


NEWPORT NEWS
HAMPTON
JAMES RIVER
ISLE OF WIGHT CO
NEWPORT NEWS CITY
HAMPTON ROADS
NORFOLK NAVAL BASE
NORFOLK
CHESAPEAKE
PORTSMOUTH
SUFFOLK
Suffolk
Battery Park
Smithfield
Carrollton
Bartlett
Sand Bay
Eclipse
Crittenden
Hudson
Sand Hansemond Shores
Chuckatuck
Oakland
Pughsville
Bellevilla
Hunterville
Disposal Area
US NAVAL SUPPLY CENTER
ELIZABETH RIVER
Willoughby Spit
Old Point Comfort
HAMPTON ROADS BRIDGE-TUNNEL
Windsor
Indian
Reeds Ferry
Reamon
Kings Fork
Myttle
Ballards Crossroads
Carrsville
Holland
Elwood
Oak Grove
Bakers Crossing
Magnolia
Deep Creek
Camden Mills
Grassfield
Geneva Park
Gilmerton
Greenwood
South Norfolk
Essex Meadows
Fentress
Whitley
Lookout Tower
Whitley Crossroads
Stotts Crossroads
Central Hill
Isle of Wight
Longview
Windy Bottom
Sleepy Hole
Pughsville
Taylorwood Estates
Radio Towers
Lookout tower
Portsmouth
Suffolk
Lookout tower
Lookout tower
Lookout tower

government, services, and trade and construction employment are increasing in the city. Many city residents commute daily to government and industrial jobs in the Newport News-Portsmouth-Norfolk areas.

The floodplains of the City of Suffolk consist of scattered residential structures, marinas, croplands, and forests. With the city's many miles of streams and shoreline, pressure for future development within the floodplains is expected.

The city enjoys a temperate climate, with moderate seasonal changes, characterized by warm summers and cool winters. Temperatures average approximately 78 degrees Fahrenheit (^{o}F) in July, the warmest month, and 42^{o}F in January, the coolest month. Annual precipitation is heavy, approximately 50 inches per year, but the light, absorbent soil facilitates infiltration (Reference 2). There is some variation in the monthly averages; however, this rainfall is distributed uniformly throughout the year. Snowfall is infrequent, generally occurring in light amounts and usually melting in a short period of time.

The city is located in the Coastal Plain province and is underlain predominantly by sand, gravel, marl, and clay strata. Elevations within the city range from sea level to approximately 85 feet.

2.3 Principal Flood Problems

The areas along the shoreline of the City of Suffolk are vulnerable to tidal flooding from major storms, commonly referred to as hurricanes and northeasters. Both storms produce winds that push large volumes of water against the shore.

Hurricanes, with their high winds and heavy rainfall, are the most severe storms to which the city is subjected. The term "hurricane" is applied to an intense cyclonic storm originating in tropical or subtropical latitudes in the Atlantic Ocean just north of the equator. While hurricanes may affect the area from May through November, nearly 80 percent occur during the months of August, September, and October with approximately 40 percent occurring during September. The most severe hurricane to strike the city occurred in August 1933.

Another type of storm that can cause severe damage to the city is the northeaster. This is also a cyclonic storm, and originates with little or no warning along the middle and northern Atlantic Coast. These storms occur most frequently in the winter months but may occur at any time. Accompanying winds are not of hurricane force, but are persistent, causing above-normal tides for long periods of time. The March 1962 northeaster was the most severe to ever hit the city.

The amount and extent of damage caused by any tidal flood will depend upon the topography of the area flooded, rate of rise in floodwaters, depth and duration of flooding, exposure to wave action, and the extent to which damageable property has been placed in the floodplain. The depth of flooding during these storms depends upon the velocity, direction, and duration of the wind; the size and depth of the body of water over which the wind is acting; and the astronomical tide. The duration of flooding depends upon the duration of the tide-producing forces. Floods caused by a hurricane are usually of a much shorter duration than the ones caused by a northeaster. Flooding from hurricanes rarely lasts more than one tidal cycle; however, flooding caused by northeasters may last several days, during which the most severe flooding takes place at the time of the peak astronomical tide.

The timing or coincidence of the maximum storm surge with the normal high tide is an important factor in the consideration of flooding from tidal sources. The mean range of tide in the Nansemond River at Suffolk is 3.8 feet. The range of tide may be somewhat less in the connecting bays and inlets (Reference 4).

The city also contains numerous estuaries of the Nansemond River that are subject to tidal flooding in their lower reaches, but fluvial flooding on the upper reaches. Flooding on the upper reaches of these streams and on tributaries of the Blackwater River and other streams in Suffolk may be caused by heavy rains occurring any time of the year. Flooding may also occur as a result of intense rainfall produced by local summer thunderstorms or tropical disturbances such as hurricanes, which move into the area from the Gulf or Atlantic coasts. Flood heights on these streams can rise from normal to extreme flood peaks in a relatively short period of time. The amount and extent of damage caused by fluvial flooding depends upon the size of the area flooded, the height of flooding, the velocity of flow, the rate of rise, and the duration of flooding. The rate of rise and duration of flooding depend largely on the time required for floodwaters to concentrate at a particular point, and on the duration and intensity of flood-producing rainfall. Stream velocities during floods depend largely on the size and shape of the cross sections, roughness conditions of the stream that tend to retard the flow, and the bed slope, all of which vary on different streams and at different locations on the same stream. During all major floods, high-velocity flood flows and hazardous conditions would exist in the main stream channel.

All development in the floodplain is subject to water damage. Some areas, depending upon exposure, are subject to high-velocity wave action, which can cause structural damage and severe erosion along the shoreline. Waves are generated by the action of wind on the

surface of the water. The northern portion of the city along the James and Nansemond Rivers and Chuckatuck Creek is vulnerable to wave damage because of the vast exposure afforded by Hampton Roads.

The City of Suffolk has experienced major storms since the early settlement of the area. Historical accounts of severe storms in the area date back several hundred years. The following paragraphs discuss some of the large storms that have occurred in recent history.

The hurricane of August 23, 1933 was one of the most severe storms that ever occurred in the Middle Atlantic region. This tropical hurricane passed inland near Cape Hatteras on August 22, passed slightly west of Norfolk, and continued towards the north accompanied by extreme high wind and tide. The storm surge in the bay and tidal estuaries was the highest of record and coincided with astronomical high tide. The water level reached a maximum of 8 feet in Hampton Roads (Reference 5).

Hurricane "Hazel," the second most destructive of recent hurricanes to strike the area, entered the mainland south of Wilmington, North Carolina, during the morning of October 15, 1954, and moved rapidly northward, passing over Norfolk and Fredericksburg in the early afternoon. The winds were from the east and southeast until the eye passed. When the eye passed, the winds shifted to the southwest with higher velocities. The hurricane surge was not as high as the August 1933 storm, although the tidal surge was superimposed on the normal high tide. In addition to damage by tidal flooding, much damage was caused to roofs, communication lines, and other structures by the high wind. Damage of this nature is characteristic of that to be expected during hurricanes (Reference 5).

The most recent flood of major proportions in the area occurred during the northeaster of March 6-8, 1962. Disastrous flooding and high waves occurred along the Atlantic seaboard from New York to Florida. This flood was unusual, even for a northeaster, since it was caused by a low pressure cell that moved from south to north past Hampton Roads and then reversed its course, moving again to the south and bringing with it huge volumes of water and high waves. The maximum flood height occurred on the morning of March 7 and reached 7.4 feet in Hampton Roads (Reference 6).

2.4 Flood Protection Measures

There are no existing flood control structures that would provide protection during major floods in the City of Suffolk. There are several measures that have provided some protection against

flooding. These include bulkheads, seawalls, and nonstructural measures for floodplain management, such as zoning codes. The "Uniform Statewide Building Code," which went into effect in September 1973, states, "where a structure is located in a 100-year flood plain, the lowest floor of all future construction or substantial improvement to an existing structure...must be built at or above that level, except for non-residential structures which may be floodproofed to that level" (Reference 7).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency and peak elevation-frequency relationships for each flooding source studied in detail affecting the community.

Ideally, flood probability estimates are based on statistical analyses of streamflow records available for the watershed under study. However, on Shingle Creek, as on numerous other streams, lack of adequate streamflow records require analysis of rainfall and runoff characteristics of the watershed in developing flood frequency estimates. These analyses involved the application of rainfall-runoff amounts to a synthetic graph (unit hydrograph) using the U. S. Geological Survey (USGS) HEC-1 computer program (Reference 8).

A summary of the drainage area-peak discharge relationships for the stream studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
SHINGLE CREEK					
At Wilroy Road	24.5	965	1,380	1,520	1,930
Downstream of Norfolk Southern Railway	22.5	955	1,330	1,465	1,860
Upstream of Norfolk Southern Railway	22.5	1,230	1,870	2,110	2,890
At White Marsh Road	3.3	1,040	1,520	1,735	2,410

Tide records for the City of Suffolk are inadequate to establish a tide-frequency relationship. However, adjacent frontages on the Hampton Roads estuary make it appropriate to adapt flood elevations defined in nearby Norfolk Harbor to the James and Nansemond Rivers and Chuckatuck Creek. An accurate record of tide heights has been maintained at Sewells Point (National Oceanic and Atmospheric Administration gage), and at Fort Norfolk (COE gage) since 1928, and at the U. S. Naval Shipyard in Portsmouth, Virginia since 1935. After adjustment for the gradual rise in local sea level, those recorded data were analyzed in accordance with standard procedures to define the tidal frequency-elevation relationship (Reference 9). A Pearson Type III distribution was determined to give the best data fit, but the 90 percent confidence band for that relationship excluded the three highest floods recorded in Norfolk Harbor (August 22, 1933; September 18, 1936; and March 7, 1962). A graphical adjustment was therefore applied to computed results for suitable agreement with recorded elevations of extreme floods. This adjusted curve was judged to be applicable to this study.

The stillwater elevations for the 10-, 50-, 100-, and 500-year floods have been determined for Hampton Roads and are summarized in Table 2, "Summary of Stillwater Elevations." The tidal frequency relationship represents the combined effect of both northeasters and hurricanes on tidal flooding and reflects the random probability of surges occurring coincident with the normal astronomical tide.

TABLE 2 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
HAMPTON ROADS				
Entire shoreline within community	6.0	7.8	8.5	9.8

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for the backwater analyses of Shingle Creek were obtained by field surveys and located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures. All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 10). Starting water-surface elevations for Shingle Creek were calculated using the slope/area method. However, in the lower reach of Shingle Creek, tidal flood elevations are higher than fluvial flood elevations and are shown on the flood profiles and the Flood Insurance Rate Map. Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Channel roughness factors (Manning's "n") used in the hydraulic computations were based on engineering judgment and field observations of the stream and floodplain areas. The channel "n" values for Shingle Creek ranged from 0.030 to 0.050, and the overbank "n" values ranged from 0.050 to 0.100.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Hydraulic analyses, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the shorelines.

Special consideration was given to the vulnerability of the City of Suffolk to wave attack. The inclusion of wave height, which is the

distance from the trough to the crest of the wave, increases the water-surface elevation. The height of a wave is dependent upon wind speed and its duration, depth of water, and length of fetch. The wave crest elevation is the sum of the stillwater elevation and the portion of the wave height above the stillwater elevation.

Areas of coastline subject to significant wave attack are referred to as coastal high hazard zones. The COE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones (Reference 11). The 3-foot wave has been determined as the minimum size wave capable of causing major damage to conventional wood frame or brick veneer structures.

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in the National Academy of Sciences (NAS) report (Reference 12). This method is based on three major concepts. First, depth-limited waves in shallow water reach a maximum breaking height that is equal to 0.78 times the stillwater depth, and the wave crest is 70 percent of the total wave height above the stillwater level. The second major concept is that the wave height may be diminished by the dissipation of energy due to the presence of obstructions such as sand dunes, dikes, seawalls, buildings, and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures described in Reference 12. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

These concepts and equations were used to compute wave heights and wave crest elevations associated with the 100-year storm surge. Accurate topographic, land-use, and land-cover data are required for the wave height analysis. Maps of the shoreline areas at a scale of 1:600 with contour intervals of 5 and 10 feet were used for the topographic data (Reference 13). The land-use and land-cover data were obtained from notes and photographs taken during field inspections.

Wave heights were computed along transects (cross section lines) that were located along the coastal areas, as illustrated in Figure 2, in accordance with the User's Manual for Wave Height Analysis (Reference 14). The transects were located with consideration given to the physical and cultural characteristics of the land so that they would closely represent conditions in their locality. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, they were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed

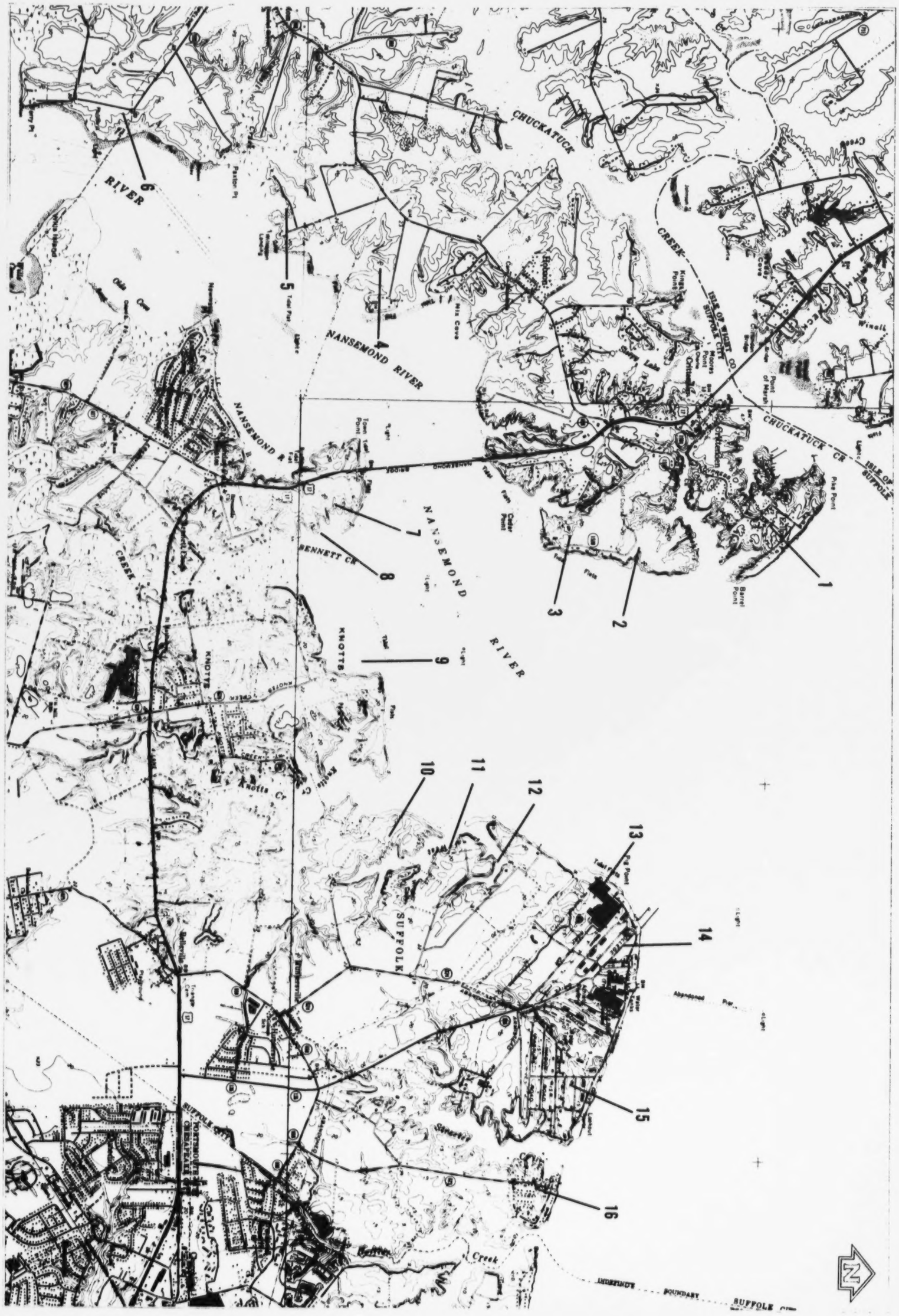


FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF SUFFOLK, VA
(INDEPENDENT CITY)

APPROXIMATE SCALE

3000 0 3000 6000 9000 FEET

TRANSECT LOCTION MAP

and in areas where computed wave heights varied significantly between adjacent transects. Table 3, "Transect Descriptions," provides a listing of the transect locations and stillwater elevations, as well as initial wave crest elevations.

TABLE 3 - TRANSECT DESCRIPTIONS

Transect	Location	Elevation (Feet NGVD) Stillwater 100-year	Elevation (Feet NGVD) Maximum Wave Elevation 100-Year[1]
No. 1	Chuckatuck Creek and James River shorelines from U. S. Route 17 bridge to Barrel Point	8.5	12.0
No. 2	Nansemond River shoreline from Barrel Point to a point approximately 2,100 feet south of Bleakhorn Creek	8.5	12.0
No. 3	Nansemond River shoreline from a point approximately 2,100 feet south of Blackhorne Creek to a point approximately 1,800 feet west of U. S. Route 17 bridge	8.5	12.0
No. 4	Nansemond River shoreline from a point approximately 1,800 feet west of U. S. Route 17 bridge to a point approximately 2,100 feet south of private road extended	8.5	12.0
No. 5	Nansemond River shoreline from a point approximately 2,100 feet south of private road extended to Campbell Creek	8.5	12.0
No. 6	Nansemond River shoreline from Campbell Creek to Ferry Point	8.5	12.0
No. 7	Nansemond River shoreline from Ferry Point to a point approximately 1,800 feet east of U. S. Route 17 bridge	8.5	12.0
No. 8	Nansemond River shoreline from a point approximately 1,800 feet east of U. S. Route 17 bridge to Bennett Creek	8.5	12.0

TABLE 3 - TRANSECT DESCRIPTIONS - continued

Transect	Location	Elevation (Feet NGVD) Stillwater 100-year	Maximum Wave Elevation[1] 100-Year
No. 9	Nansemond River shoreline from Bennett Creek to Knotts Creek	8.5	12.0
No. 10	Nansemond River shoreline from Knots Creek to West Creek	8.5	12.0
No. 11	Nansemond River shoreline from West Creek to a point approximately 2,220 feet north of West Creek	8.5	12.0
No. 12	Nansemoud River shoreline from a point approximately 2,220 feet north of West Creek to a point approximately 2,400 feet south of Park Drive extended	8.5	12.0
No. 13	Nansemond River shoreline from a point approximately 2,400 feet south of Park Drive extended to a point approximately 540 feet south of College Drive extended	8.5	12.0
No. 14	Hampton Roads shoreline from a point approximately 540 feet south of College Drive extended to South Road extended	8.5	12.0
No. 15	Hampton Roads shoreline from South Road extended to Streeter Creek	8.5	12.0
No. 16	Hampton Roads shoreline from Streeter Creek to Hoffler Creek	8.5	12.0

[1]Due to map scale limitations, the maximum wave crest elevation may not be shown on the FIRM.

Each transect was taken perpendicular to the shoreline and extended inland to a point where wave action ceased. Along each transect, wave heights and wave crest elevations were computed considering the combined effects of changes in ground elevation, vegetation, and

physical features. The 100-year stillwater elevations were used as the starting elevations for these computations. Wave heights were calculated to the nearest 0.1 foot, and wave crest elevations were determined at whole-foot increments along the transect. The location of the three-foot breaking wave for determining the terminus of the V zone (area with velocity wave action) was also computed at each transect. It was assumed that the beach area would erode during a major storm, thus reducing its effectiveness in decreasing wave heights.

After analyzing wave heights along each transect, wave crest elevations were interpolated between transects. Various source data were used in the interpolation, including the topographic work maps, notes and photographs taken during field inspection, and engineering judgment. Controlling features affecting the wave crest elevations were identified and considered in relation to their positions at a particular transect and their variation between transects. The results of the calculations are accurate until local topography, vegetation or cultural development within the community undergo any major changes. The results of this analysis are summarized in Table 4.

TABLE 4 - TRANSECT DATA

Flooding Source	Stillwater Elevation 10-Year	50-Year	100-Year	500-Year	Zone	Base Flood Elevation (Feet NGVD)*
HAMPTON ROADS						
Transects 1-16	6.0	7.4	8.5	9.4	VE	11-12
					AE	8.5-11

*Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:600 with contour intervals of 5 and 10 feet (Reference 13). For tidal areas without wave action, the 100-year and 500-year boundaries were delineated using the topographic maps referenced above.

For the tidal areas with wave action, the flood boundaries were delineated using the elevations determined at each transect; between transects, the boundaries were interpolated using engineering judgment, land-cover data, and topographic maps. The 100-year floodplain was divided into whole-foot elevation zones based on the average wave crest elevation in that zone. Where the map scale did not permit these zones to be delineated at one-foot intervals, larger increments were used.

For the flooding sources studied by approximate methods, the 100-year floodplain boundaries were delineated using the topographic maps referenced above, slope/area computations, and the Flood Hazard Boundary Map for the City of Suffolk (References 13 and 15).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, and VE), and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the flooding sources studied by approximate methods, only the 100-year floodplain boundary is shown on the Flood Insurance Rate Map (Exhibit 2).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and

increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this study is presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this study was computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 5). The computed floodway is shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 3.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 5 for certain downstream cross sections of Shingle Creek are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Shingle Creek								
A	6,940	182	1,310	1.2	8.5	7.9[2]	8.9	1.0
B	7,700	115	995	1.5	10.7	10.7	11.3	0.6
C	8,750	185	1,810	0.8	10.8	10.8	11.5	0.7
D	9,500	135	1,265	1.2	10.9	10.9	11.6	0.7
E	10,600	195	1,710	0.9	11.1	11.1	11.8	0.7
F	11,200	175	1,375	1.1	11.2	11.2	11.9	0.7
G	11,500	75	635	2.3	11.7	11.7	12.1	0.4
H	12,240	150	1,150	1.3	12.0	12.0	12.6	0.6
I	12,500	301	2,560	0.8	18.3	18.3	19.3	1.0
J	13,250	229	2,560	0.8	18.3	18.3	19.3	1.0
K	14,330	202	1,895	1.1	18.5	18.5	19.4	0.9
L	15,050	211	1,860	1.1	18.7	18.7	19.6	0.9
M	16,200	233	1,685	1.1	19.0	19.0	19.8	0.8
N	17,100	125	985	1.9	19.5	19.5	20.2	0.7
O	17,650	125	1,030	1.7	22.5	22.5	22.9	0.4
P	18,200	140	1,010	1.8	22.7	22.7	23.3	0.6
Q	18,700	125	580	3.0	22.8	22.8	23.8	1.0
R	19,100	125	920	1.9	26.3	26.3	26.5	0.2
S	19,500	125	945	1.8	26.5	26.5	26.9	0.4

[1]Feet above confluence with the Nansemond River
[2]Elevation computed without consideration of backwater effects from the Nansemond River

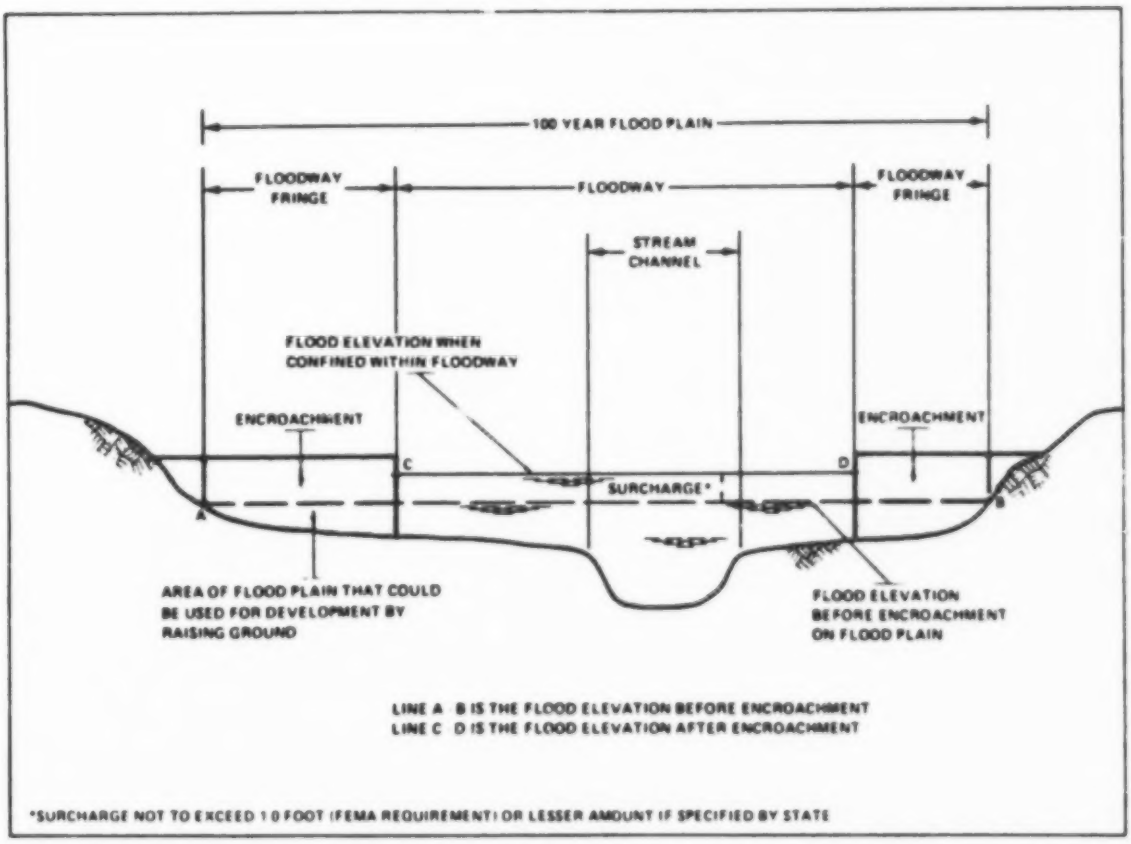
TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF SUFFOLK, VA
(INDEPENDENT CITY)

FLOODWAY DATA

SHINGLE CREEK


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

Floodway Schematic - Figure 3

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

7.0 OTHER STUDIES

A Flood Plain Information Report was prepared by the COE for coastal flooding in Norfolk (Reference 16). The results of this study are in agreement with the results of that report.

Flood Insurance Studies have been prepared for the Cities of Portsmouth and Chesapeake and the unincorporated areas of Southampton County (References 17, 18, and 19). The results of this study are in exact agreement with the results of those studies.

A Flood Insurance Study is currently being prepared for the unincorporated areas of Isle of Wight County (Reference 20). The results of that study will be in exact agreement with the results of this study.

Because it is based on more detailed analyses, this study supersedes the Flood Hazard Boundary Map for the City of Suffolk (Reference 15).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

9.0 BIBLIOGRAPHY AND REFERENCES

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13. Benatec Associates of Columbus, Ohio, Topographic maps prepared by photographic methods from USGS 7.5-Minute Series topographic maps, Scale 1" = 600', Contour Intervals 5 and 10 Feet: City of Suffolk, Virginia, 1986. The following USGS 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Intervals 5 and 10 Feet, were used: Benns Church, Virginia, 1965, Photorevised 1980; Newport News South, Virginia, 1964, Photorevised 1980; Windsor, Virginia, 1965, Photorevised 1980; Chuckatuck, Virginia, 1965, Photorevised 1979; Bowers Hill, Virginia, 1965, Photorevised 1979; Franklin, Virginia, 1967, Photorevised 1980; Holland, Virginia, 1967, Photorevised 1979; Buckhorn, Virginia, 1954, Photorevised 1979; Suffolk, Virginia, 1977; Lake Drummond NW, Virginia, 1954; Riverdale, Virginia-North Carolina, 1967; Gates, North Carolina-Virginia, 1967, Photorevised 1981; Corapeake, Virginia-North Carolina, 1977; Lake Drummond, Virginia-North Carolina, 1977.

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17. Federal Emergency Management Agency, Flood Insurance Study, City of Portsmouth, Independent City, Virginia, Washington, D. C., November 2, 1983.

18. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, City of Chesapeake, Independent City, Virginia, Washington, D. C., February 2, 1977.

19. Federal Emergency Management Agency, Flood Insurance Study, Unincorporated Areas of Southampton County, Virginia, Washington, D. C., December 15, 1982.

20. Federal Emergency Management Agency, Flood Insurance Study, Unincorporated Areas of Isle of Wight County, Virginia (Unpublished).

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	03	10.61	USC&GS disk, stamped TIDAL No. 6, set on top of southeast end of southwest concrete curbing of U. S. Route 17 bridge over Chuckatuck Creek.
RM 2	03	21.33	USGS cap, stamped PRIM TRAV STA NO 2 1918 C ELEV 21, set on top of iron pipe, on northeast side of Steeple Drive, approximately 275 feet northwest of intersection of Eclipse Drive.
RM 3	03	23.47	USC&GS disk, stamped T 282 RESET 1971, set in top of concrete post flush with ground, on U. S. Route 17 approximately 250 feet northwest of junction of State Route 628, approximately 48 feet southeast of power pole No. 36 with transformer, approximately 21 feet west of centerline of southbound lane of U. S. Route 17.
RM 4	03	23.41	USC&GS disk, stamped Q 309 1952, set in top of concrete post projecting one inch above ground, approximately 1.15 miles southwest along State Route 628 from post office at Hobson, near junction of private road leading southeast, approximately 25 feet southeast of centerline of State Route 628 and approximately 27 feet northeast of centerline of private road.
RM 5	04	13.56	USC&GS disk, stamped J 309 1952, set in top of west corner of concrete foundation for southwest leg of westernmost of two water towers; tower is located on Frederick Campus of Tidewater Community College; foundation is approximately 83 feet northeast of centerline of Shore Drive and approximately 100 feet southwest of south shoreline of Hampton Roads.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 6	04	13.41	USC&GS disk, stamped K 309 1952, set in top of west corner of concrete foundation for northwest leg of easternmost of two water towers; tower is located on Frederick Campus of Tidewater Community College; foundation is approximately 61 feet northeast of centerline of Shore Drive and approximately 150 feet southwest of south shoreline of Hampton Roads.
RM 7	06	29.65	USC&GS disk, stamped 29.797 A 27 1932, set in top of north end of west concrete headwall of 15-inch pipe culvert; culvert is located along State Routes 10 & 32, approximately 0.5 mile north of junction of State Routes 10 & 32 and 125 in Chuckatuck; disk is approximately 21 feet west of centerline of State Routes 10 & 32 and approximately 15 feet northeast of power pole No. 196.
RM 8	06	70.71	USC&GS disk, stamped 70.820 Z 26 1932, set in top of concrete post projecting two inches above ground; disk is located at junction of State Routes 10 & 32 and 741; approximately 22 feet east of centerline of State Routes 10 & 32; and approximately 16.5 feet northeast of centerline of State Route 741.
RM 9	07	20.34	USC&GS disk, stamped U 452 1971, set on top of copper-coated rod approximately two inches below ground; disk is located along U. S. Route 17 near junction of Bennett Creek Lane leading northeast and State Route 627 leading southwest; mark is approximately 122.5 feet northwest of northwest corner of main building of Nansemond River Baptist Church, approximately 50.5 feet east of centerline of northbound lane of U. S. Route 17, approximately 234.5 feet north of centerline of Bennett Creek Lane.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 10	07	28.66	USC&GS disk, stamped M 309 RESET 1967, set on top of north end of east concrete abutment of U. S. Route 17 bridge (eastbound lane) over Bennett Creek.
RM 11	07	17.58	USC&GS disk, stamped R 452 1971, set on top of copper-coated rod two inches below ground; mark is located on southeast corner of junction of U. S. Route 17 and State Route 626; disk is approximately 33 feet south of centerline of eastbound lane of U. S. Route 17, approximately 61.5 feet east of centerline of State Route 626, approximately 103 feet northwest of northwest corner of brick gas station.
RM 12	08	20.52	USC&GS disk, stamped F 309 1952, set in top of concrete post along State Route 658, approximately 0.1 mile southwest of junction of State Routes 658 and 135; mark is approximately 20 feet northwest of centerline of State Route 658 and approximately 45 feet west of power pole No. TB 78.
RM 13	08	19.29	USC&GS disk, stamped X 282 RESET 1966, set in top of concrete post projecting one inch above ground, along State Route 658, approximately 106 yards north of centerline of westbound lane of U. S. Route 17, approximately 17 feet east of centerline of State Route 658, approximately 71 feet south of northwest corner of small cemetery, approximately three feet south of power pole No. 108, and approximately 3.5 feet west of hedge row.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 14	08	20.18	USC&GS disk, stamped L 309 1952, set in top of concrete post projecting one inch above ground, located approximately 0.8 mile east along U. S. Route 17 from junction of State Route 626, approximately 39 feet north of centerline of westbound lane of U. S. Route 17, approximately 15 feet west of centerline of driveway leading north, and approximately seven feet east of power pole No. 68.
RM 15	11	34.16	USC&GS disk, stamped 34.301 Y 26 1932, set in top of west headwall of 24-inch pipe culvert, approximately 2.15 miles south along State Routes 10 & 32 from junction of State Routes 10 & 32 and 741; disk is approximately 18 feet west of centerline of State Routes 10 & 32, and approximately 68 feet south-southeast of power pole No. 119.
RM 16	16	57.10	USC&GS disk, stamped D 324 1953, set in top of concrete post projecting three inches above ground, along State Routes 10 & 32, approximately 1.25 miles north of junction of State Routes 10 & 32 and U. S. Route 460; mark is on outside of curve, approximately 36 feet east of centerline of State Routes 10 & 32, approximately 36 feet north-northeast of power pole No. 539.
RM 17	16	46.05	USC&GS disk, stamped E 324 RESET 1970, set in top of concrete post flush with ground, approximately 0.3 mile north along State Routes 10 & 32 from junction of State Routes 10 & 32 and U. S. Route 460; mark is approximately 38 feet east of centerline of State Routes 10 & 32.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 18	23	34.43	USC&GS disk, stamped F 324 RZSET 1963, set in top of concrete post flush with ground, along U. S. Route 460, approximately 0.9 mile north of junction of U. S. (Bus.) Routes 460 and 58 on property of radio station WLPM; mark is approximately 115 feet south of south edge of road leading to cemetery, approximately 110 feet northeast of radio tower, and approximately 16.5 feet north of northwest corner of radio station building.
RM 19	23	36.05	USC&GS disk, stamped ELEV 36.112 FT, set vertically in south face of CSX Transportation station; disk is approximately 8.2 feet west of southeast corner of building, approximately 13.5 feet north of north rail of main track, approximately 195 feet east of center of crossing of State Route 32 (North Main Street) and CSX Transportation, and approximately 3.5 feet above ground.
RM 20	23	44.54	USC&GS disk, stamped SUFFOLK 1918 1966 BM RESET, set in top of concrete post projecting two inches above ground, along CSX Transportation, approximately 96 feet west of northwest corner of south abutment of Pinner Street overpass, and approximately 54 feet south of south rail of main track.
RM 21	23	26.24	Chiseled square in southeast corner of drain inlet at northwest corner of intersection of Elizabeth Street and U. S. (Bus.) Route 58 (Constance Road).
RM 22	23	7.27	Old chisel set with slant in abutment tie at northwest end of southwest abutment of Oak Island bridge over Shingle Creek.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 23	23	28.03	Chiseled square in southeast corner of concrete base for traffic light support pole located in north corner of intersection of State Route 642 (Wilroy Road) and U. S. Route 58 (Constance Road).
RM 24	23	7.70	Chiseled square set in west end of south abutment of State Route 642 (Wilroy Road) bridge over Shingle Creek.
RM 25	23	22.14	Railroad spike set in west end of south abutment of Norfolk Southern bridge over Shingle Creek.
RM 26	23	33.70	Chiseled square set in northwest end of southwest abutment of CSX Transportation bridge over Shingle Creek.
RM 27	23	12.62	Chiseled square set in southwest end of northwest abutment of U. S. (Bus.) Routes 58 & 460 bridge over Shingle Creek.
RM 28	23	14.15	USC&GS disk, stamped R 323 1953, set one foot south of north end of west abutment of 20-foot bridge along Norfolk Southern, approximately one mile southwest of crossing of State Route 337 at Magnolia, approximately 0.1 mile east of overpass of CSX Transportation, and approximately six feet north of north rail of Norfolk Southern.
RM 29	23	22.06	Chiseled square set in northwest end of southwest abutment of CSX Transportation bridge (eastbound track) over Shingle Creek.
RM 30	23	13.00	Chiseled cross on top of round concrete pipe under east side of sidewalk in front of house No. 2231 on east end of Florida Avenue.
RM 31	23	23.40	Top of railroad spike in centerline of asphalt at east end of Arizona Avenue.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

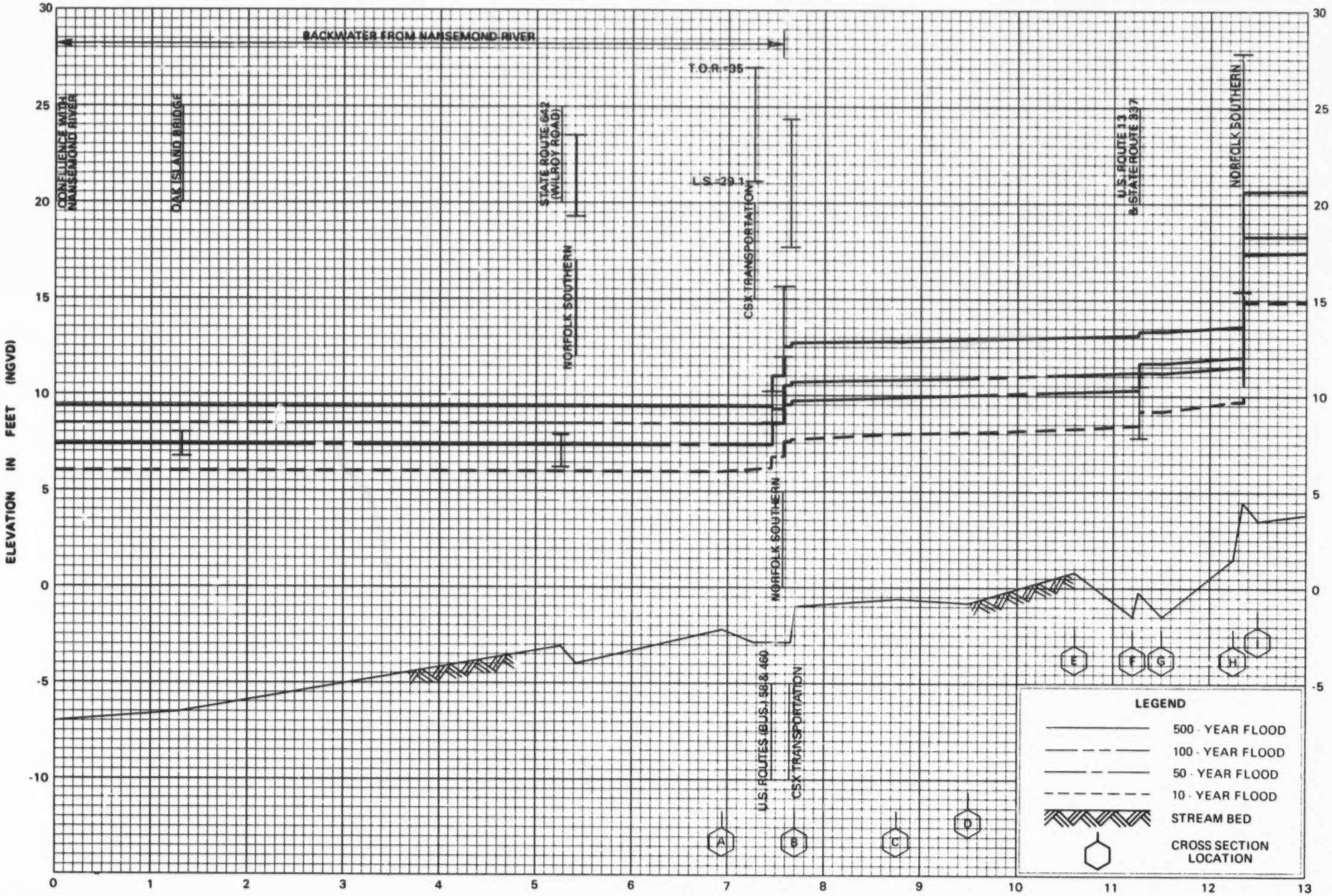
Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 32	23	10.94	Chiseled square set in west end of north abutment of State Route 337 bridge over Shingle Creek.
RM 33	23	19.48	Chiseled square on top of curb on southeast side of Washington Street at junction of Washington Street and Hollywood Avenue; square is in line with extended centerline of Hollywood Avenue.
RM 34	23	20.77	Chiseled cross set on south rim of manhole located on north side of Norfolk Southern tracks on west (left) bank of Shingle Creek.
RM 35	23	30.37	USGS disk, stamped TT 29 T 1939, set on Norfolk Southern bridge crossing State Route 337 and U. S. Route 13; disk is approximately 20 feet south of south rail of eastbound track directly over center of highway.
RM 36	23	25.80	Chiseled cross on west side of manhole rim at intersection of 12th Street and Rosemont Avenue.
RM 37	23	32.17	Railroad spike on power pole No. PO 87, located in cul-de-sac at northeast end of Truman Road.
RM 38	23	25.14	Chiseled cross on east side of manhole rim at intersection of 10th Street and Rosemont Avenue.
RM 39	23	25.63	Chiseled cross on east side of manhole rim at intersection of 8th Street and Rosemont Avenue.
RM 40	23	22.07	Chiseled square set in northwest corner of sidewalk on northeast side of 6th Street bridge over Shingle Creek.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 41	23	25.14	Square cut in metal strip on northwest corner of drain inlet on south side of State Route 642 (White Marsh Road) approximately 58 feet east of centerline of State Route 642 (White Marsh Road) bridge over Shingle Creek.
RM 42	23	43.88	Chiseled cross on west side of manhole rim at intersection of Adams and Walnut Streets.
RM 43	23	42.31	Chiseled cross on west side of manhole rim at intersection of Adams and Maple Streets.
RM 44	23	44.63	Chiseled cross on west side of manhole rim at intersection of Adams and Mulberry Streets.
RM 45	23	45.06	Chiseled cross on west side of manhole rim at intersection of Adams and Factory Streets.
RM 46	23	48.77	USC&GS disk, stamped Y 324 1953, set in top of east side of concrete base of east-southeast leg of large water tower; disk is in northwest corner of junction of Johnson Avenue and County Street, approximately 58 feet north of north curb of Johnson Avenue, and approximately 27 feet west of west curb of County Street.
RM 47	23	23.97	USC&GS disk, satmped Q 323 1953, set in top of concrete post projecting three inches above ground, along Norfolk Southern, approximately 128 feet northeast of center of crossing of State Route 337 at Magnolia; approximately 49 feet north of north rail of CSX Transportation, approximately 27.5 feet south of south rail of Norfolk Southern Railway, and approximately 1.5 feet below level of track.

EXHIBIT 3 - ELEVATION REFERENCE MARKS - continued

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 48	23	22.21	USC&GS disk, stamped P 9 SHADE 1918 V, set in top of concrete post projecting two inches above ground, approximately 0.5 mile east along CSX Transportation from junction of railroad and State Route 337 at Magnolia; disk is approximately 20 feet north of north rail of CSX Transportation, approximately 53.5 feet south of south rail of Norfolk Southern.
RM 49	23	20.47	USC&GS disk, stamped F 324 RESET 1963, set in top of south end of east abutment of 10-foot bridge along Norfolk Southern, approximately 0.7 mile east of junction of railway and State Route 337 at Magnolia; disk is approximately 65.5 feet north of north rail of CSX Transportation, approximately seven feet south of south rail of Norfolk Southern, and approximately 4.5 feet north of south end of east abutment of bridge.



FLOOD PROFILES

SHINGLE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF SUFFOLK, VA
(INDEPENDENT CITY)

01P

ELEVATION IN FEET (NGVD)

0 5 10 15 20 25 30

13 14 15 16 17 18 19 20

STREAM DISTANCE IN THOUSANDS OF FEET ABOVE CONFLUENCE WITH NANSEMOND RIVER

J K L M N O P Q R S

6TH STREET SOUTH

STATE ROUTE 642
(WHITE MARSH ROAD)

LIMIT OF DETAILED STUDY

LEGEND

500 - YEAR FLOOD

100 - YEAR FLOOD

50 - YEAR FLOOD

10 - YEAR FLOOD

STREAM BED

CROSS SECTION LOCATION

5 10 15 20 25 30

02P

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF SUFFOLK, VA
(INDEPENDENT CITY)

FLOOD PROFILES

SHINGLE CREEK